NAVWEPS 17-20AQ-01
NAVSHIPS

Technical Manual

Instrument Calibration Procedure

AQ-01

SERVO ANALYZER
(SERVOSCOPE)
SERVO CORPORATION
1100A, B, C, D

DEPARTMENT OF THE NAVY
BUWEPS-BUSHIPS CALIBRATION PROGRAM

Prepared By
Metrology Department, Pomona, California

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PREFACE

This procedure has been prepared specifically for those laboratories participating in the Navy Calibration Program. The government assumes no responsibility for its use by other agencies.

The instruments utilized in this procedure were selected from those known to be at the disposal of the participating laboratories, and the listing by make and model number carries no implication of preference, recommendation, or approval by the Navy for use by other agencies. It is recognized that equivalent equipment produced by other manufacturers may be capable of equally satisfactory performance in the procedure.

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SAFETY SUMMARY

This summary contains all WARNINGS used in this procedure and the corresponding page numbers. All personnel concerned with calibrating, operating, or maintaining the equipment must fully understand the hazards, and must be familiar with approved safety precautions and procedures. Before proceeding, post an appropriate "DANGER" sign at the work station and ensure that another person is in the area and aware of the work in process.

WARNING - This procedure involves voltages that are hazardous to personnel. Before proceeding, post a DANGER HIGH VOLTAGE sign at the work area, and ensure that another person is in the area and aware of the work in progress..... Page 4

WARNING - Voltages hazardous to life are present on the equipment used throughout this procedure. Use extreme caution and only one hand when making connections. Never touch bare terminals or bare leads. Use insulated leads. Be careful.....Page 5

1. INTRODUCTION

1.1 This procedure describes the calibration of any of the Servo Corporation Servo Analyzers (Servoscopes), models 1100A, B, C, or D, herein referred to as the Test Instrument.

1.2 The Test Instrument is essentially a low-frequency signal generator, capable of measuring the phase and amplitude response of the servomechanism under test with respect to the signals generated by the Test Instrument. A total frequency range of .001 to 60 cps is covered by four models. A linear sweep, synchronized with the output signals, is generated by the Test Instrument to provide an external oscilloscope presentation. The calibration is performed as follows:

1.2.1 The AMPLITUDE meter is calibrated against an external a-c reference source.

1.2.2 The power supply voltage and regulation tests are performed by measuring the various voltages while the input line voltage is varied from 105 to 125 volts.

1.2.3 The output frequency is measured with an electronic counter in terms of period (reciprocal of frequency). The accuracy of the FREQUENCY meter is determined with the counter.

1.2.4 The amplitude and linearity of the sweep output are measured with an oscilloscope. The sweep output waveform is observed for distortion on the oscilloscope. The operation of the sweep controls is functionally tested with a VOM and the oscilloscope.

1.2.5 The reference amplifier is tested for zero phase shift by applying signals of the same phase to the amplifier and the oscilloscope horizontal input. The amplifier output is then applied to the oscilloscope vertical input. Any phase error is indicated as an ellipse on the oscilloscope.

1.2.6 The carrier amplifier phase shift is determined in a manner similar to the reference amplifier test.

1.2.7 Correct phasing of the Test Instrument servo system is determined by observing the modulated carrier output in reference to the sweep output on the oscilloscope.

1.2.8 The square-wave and sine-wave output signals are observed for distortion, and their amplitudes measured on the oscilloscope.

1.2.9 The null output voltage from the phase-sensitive demodulator is measured with an EVM.

1.3 All measurement data must be recorded on the calibration checklist, a sample of which is included at the end of this procedure. Tests performed to verify Test Instrument operating characteristics should be noted on the checklist by placing checks in the spaces provided.

1.4 The estimated time for a routine calibration, excluding repair, maintenance, and unusual adjustment, is:

Setup time	1.0 hr
Calibration time	4.0 hr
Total	5.0 hr

2. EQUIPMENT REQUIRED (OR EQUIVALENT)

NOTE

All instruments used during this calibration must bear current calibration servicing identification labels.

	Substitute Equipment[1]
2.1 Oscilloscope: HP 130A or B	
2.2 VOM: Simpson 269	
2.3 Counter, electronic: HP 524D, C, or B with the HP 525A plug-in unit installed, or an FR-38A/USM-26 with the MX-1637/USM-26 installed	
2.4 Divider, decade voltage: General Radio 1454-A or Gray E2553	
2.5 Source, AC reference: Sorenson VRSAC-751	
2.6 Autotransformer: Superior Electric UC 1M or GR W5MT3A	
2.7 EVM: HP 400H or L	
2.8 Interconnecting leads as required	

3. PRELIMINARY OPERATIONS

3.1 PRELIMINARY INSPECTION

3.1.1 Remove the Test Instrument case by removing the two screws near the lower edge on each side, and lifting it from the Test Instrument.

3.1.2 Set the case out of the way for the rest of the procedure.

3.1.3 Inspect the Test Instrument for cleanliness, damage, loose tubes and correct fuse rating (line power: 2 amp, 250 volt; carrier power: 1/8 amp, 250 volt). Take any necessary corrective action.

3.2 AMPLITUDE METER TEST

3.2.1 Set the AC reference source controls as follows:

100 volt/step switch to	0
10 volt/step switch to	0
1 volt/step switch to	0
.1 volt/step switch to	.0
ON-STANDBY switch to	STANDBY

[1] "Equipment Substitution Requirements," appendix A

3.2.2 Connect the AC reference source to the appropriate power source, and allow it to warm up for 10 minutes before using.

3.2.3 Adjust the mechanical zero of the Test Instrument meters, if necessary, for a zero indication.

3.2.4 Remove the two wires from the meter terminals. (Label the wires for future reference.)

3.2.5 Connect the Test Instrument AMPLITUDE meter terminals to the AC reference source 10 to 799.9 VOLTS terminals.

3.2.6 Adjust the AC reference source VOLT. ADJ. control as necessary for a red-line indication.

3.2.7 Set the AC reference source controls as follows:

10 volt/step switch to	50
ON-STANDBY switch to	ON

3.2.8 Adjust the AC reference source VOLT. ADJ. control as necessary for a red-line indication.

3.2.9 Record the Test Instrument AMPLITUDE meter indication.

3.2.10 Set the AC reference source 10 volt/step switch to 40.

3.2.11 Record the Test Instrument AMPLITUDE meter indication.

3.2.12 Set the AC reference source 10 volt/step switch to 30.

3.2.13 Record the Test Instrument AMPLITUDE meter indication.

3.2.14 Set the AC reference source 10 volt/step switch to 20.

3.2.15 Record the Test Instrument AMPLITUDE meter indication.

3.2.16 Set the AC reference source 10 volt/step switch to 10.

3.2.17 Record the Test Instrument AMPLITUDE meter indication.

3.2.18 Verify that the indications recorded in steps 3.2.9 through 3.2.17 are within tolerance; if not, take the required corrective action and repeat steps 3.2.1 through 3.2.18.

3.2.19 Set the AC reference source controls as follows:

10 volt/step switch to	0
ON-STANDBY switch to	STANDBY

3.2.20 Disconnect the AC reference source.

3.2.21 Replace the wires, washers, and nuts removed in step 3.2.4. (Be certain to put the proper wires on the appropriate terminals.)

3.3 INITIAL CONDITIONS

WARNING

THIS PROCEDURE INVOLVES VOLTAGES THAT ARE HAZARDOUS TO PERSONNEL. BEFORE PROCEEDING, POST A DANGER HIGH VOLTAGE SIGN AT THE WORK AREA, AND ENSURE THAT ANOTHER PERSON IS IN THE AREA AND AWARE OF THE WORK IN PROGRESS.

3.3.1 Set the EVM Range switch to 300 VOLTS.

3.3.2 Adjust the oscilloscope INTENSITY control fully ccw.

3.3.3 Adjust the Test Instrument AMPLITUDE INCREASE and FREQUENCY INCREASE controls fully ccw.

3.3.4 Set the autotransformer voltage control fully ccw.

3.3.5 Connect all applicable equipment, except the Test Instrument, to the appropriate power source, making sure that all power switches are off.

3.3.6 Connect the Test Instrument lower INPUT terminal to earth ground.

3.3.7 Connect the Test Instrument 60~ power cord to the autotransformer. Do not connect the 50-800~ carrier power cord.

3.3.8 Turn all power switches on.

3.3.9 Adjust the autotransformer voltage control for a meter indication of 115 volts.

NOTE

The autotransformer adjustment should be checked occasionally during this procedure.

3.3.10 Allow all equipment to warm up for 10 minutes before using.

3.3.11 Verify that the Test Instrument POWER light is illuminated; if not, take any required corrective action.

4. POWER SUPPLY TESTS

4.1 INITIAL CONDITIONS

4.1.1 Adjust the autotransformer voltage control fully ccw.

4.1.2 Place the Test Instrument on its left-hand side.

4.1.3 Remove the Test Instrument bottom panel.

4.1.4 Set the VOM range switch (right-hand knob) as necessary for a range indication, under the glass, of 400 VDC.

4.1.5 Connect a set of test leads to the VOM POS. and COM. terminals (the leads must have insulated clips on the free ends).

4.2 B+ POWER TEST

4.2.1 Connect the VOM COM. test lead to the Test Instrument lower INPUT terminal.

4.2.2 Connect the VOM POS. test lead to pin number 4 of V-103 (refer to figure 1).

WARNING

VOLTAGES HAZARDOUS TO LIFE ARE PRESENT ON THE EQUIPMENT USED THROUGHOUT THIS PROCEDURE. USE EXTREME CAUTION AND ONLY ONE HAND WHEN MAKING CONNECTIONS. NEVER TOUCH BARE TERMINALS OR BARE LEADS. USE INSULATED LEADS. BE CAREFUL.

4.2.3 Adjust the autotransformer voltage control for a meter indication of 115 volts, and allow five minutes for the Test Instrument to warm up.

NOTE

Tube pin numbers are numbered cw from the empty space or keyway when looking at the tube or socket from the bottom.

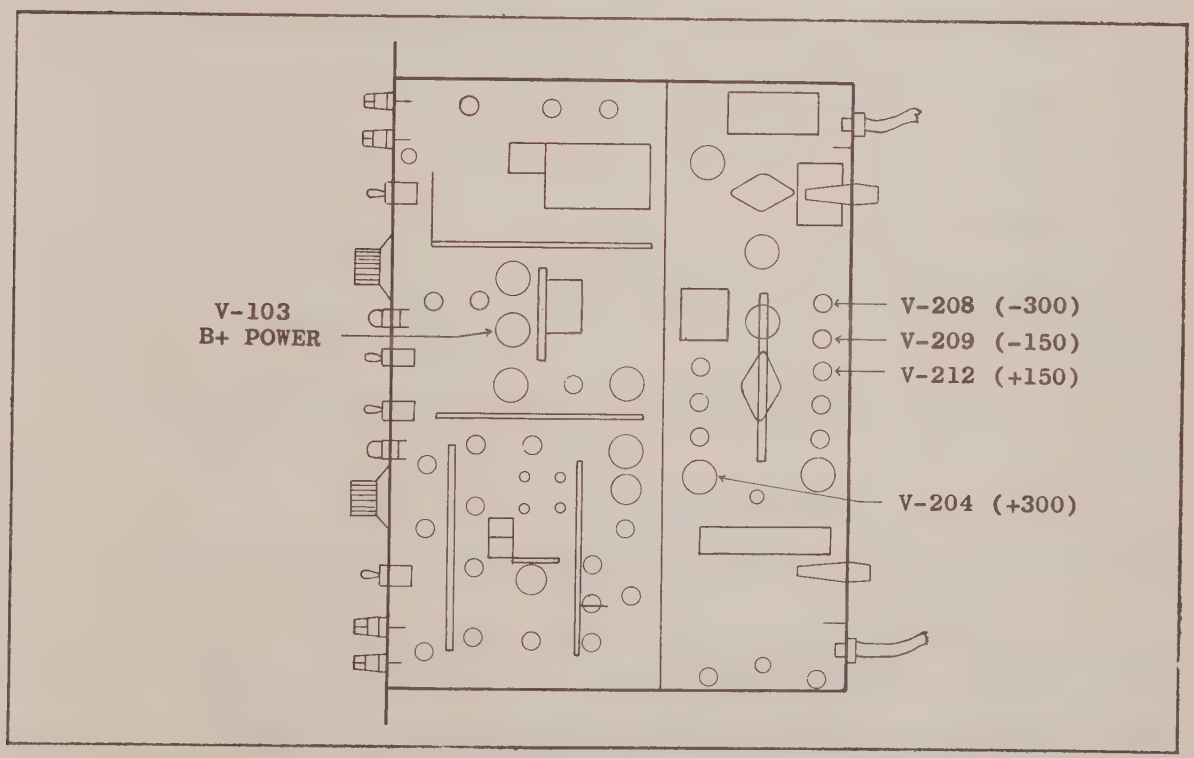

Figure 1. Bottom View of Test Instrument

4.2.4 Record the VOM indication.

4.2.5 Adjust the autotransformer voltage control fully ccw.

4.2.6 Disconnect the VOM POS. test lead from the Test Instrument.

4.3 +300 VOLT TESTS

4.3.1 Connect the VOM POS. test lead to pin number 8 of V-204 (refer to figure 1).

4.3.2 Adjust the autotransformer voltage control for a meter voltage indication of 115 volts, and allow five minutes for the Test Instrument to warm up.

4.3.3 Record the VOM indication.

4.3.4 Adjust the autotransformer voltage control for a meter indication of 105 volts.

4.3.5 Record the VOM indication as the "NOMINAL" value. Adjust the autotransformer voltage control for an indication of 125 volts on the meter. Record the VOM indication as the MEASURED value.

NOTE

Wait at least 30 seconds after changing the autotransformer voltage control before recording the indication.

4.3.6 Adjust the autotransformer voltage control fully ccw.

4.3.7 Disconnect the VOM POS. test lead from the Test Instrument.

4.4 +150 VOLT TESTS

4.4.1 Set the VOM range selector to 160 VDC.

4.4.2 Connect the VOM POS. test lead to pin number 1 of V-212 (refer to figure 1).

4.4.3 Adjust the autotransformer voltage control for an indication of 115 volts on the meter, and allow five minutes for the Test Instrument to warm up.

4.4.4 Record the VOM indication.

4.4.5 Adjust the autotransformer voltage control for a meter indication of 105 volts.

4.4.6 Record the VOM indication as the "NOMINAL" value. Adjust the autotransformer voltage control for a meter indication of 125 volts. Record the VOM indication as the MEASURED value.

4.4.7 Adjust the autotransformer voltage control fully ccw.

4.4.8 Disconnect the VOM test leads from the Test Instrument.

4.5 -150 VOLT TESTS

4.5.1 Connect the VOM POS. test lead to the Test Instrument lower INPUT terminal.

4.5.2 Connect the VOM COM. test lead to pin number 7 of the V-209 (refer to figure 1).

4.5.3 Adjust the autotransformer voltage control for a meter indication of 115 volts, and allow five minutes for the Test Instrument to warm up.

4.5.4 Record the VOM indication.

4.5.5 Adjust the autotransformer voltage control for a meter indication of 105 volts.

4.5.6 Record the VOM indication as the NOMINAL value. Adjust the autotransformer voltage control for a meter indication of 125 volts. Record the VOM indication as the MEASURED value.

4.5.7 Adjust the autotransformer voltage control fully ccw.

4.5.8 Disconnect the VOM COM. test lead from the Test Instrument.

4.6 -300 VOLT TESTS

4.6.1 Set the VOM range selector to 400 VDC.

4.6.2 Connect the VOM COM. test lead to pin number 7 of V-208 (refer to figure 1).

4.6.3 Adjust the autotransformer voltage control for a meter indication of 115 volts, and allow five minutes for the Test Instrument to warm up.

4.6.4 Record the VOM indication.

4.6.5 Adjust the autotransformer voltage control for a meter indication of 105 volts.

4.6.6 Record the VOM indication as the NOMINAL value. Adjust the autotransformer voltage control for a meter indication of 125 volts. Record the VOM indication as the MEASURED value.

4.6.7 Adjust the autotransformer voltage control fully ccw.

4.6.8 Disconnect the VOM.

4.6.9 Place the Test Instrument in the normal upright position.

4.6.10 Adjust the autotransformer control for a meter indication of 115 volts, and allow five minutes for the Test Instrument to warm up.

4.7 TEST INSTRUMENT EVALUATION

4.7.1 Verify that the indications recorded in steps 4.2.4 through 4.6.6 are within tolerance; if not, take the required corrective action and repeat steps as applicable.

5. FREQUENCY TESTS

5.1 INITIAL CONDITIONS

5.1.1 Set the Test Instrument controls as follows:

PHASE dial to	0
AMPLITUDE INCREASE control	fully ccw
Function selector to	SINE WAVE
FREQUENCY range switch to	STANDBY
FREQUENCY INCREASE control	fully ccw
Y-AXIS switch to	OUTPUT
SWEEP BALANCE control to	0
SWEEP WIDTH control	fully cw
X-AXIS switch to	SWEEP
CARRIER switch to	ON
(1100D only) High-Low switch to	.1 TO 20

5.1.2 Perform a self-check on the electronic counter as outlined in the Laboratory Practices Notebook.

5.1.3 Set the electronic counter controls as follows:

FUNCTION SELECTOR to	PERIOD
STD. FREQ. COUNTED switch to	100 KC
MIXING FREQUENCY MCS switch to	0
GAIN control	fully ccw

5.1.4 Connect the Test Instrument OUTPUT terminals to the electronic counter SIGNAL INPUT connector.

5.1.5 Adjust the Test Instrument FREQUENCY ZERO ADJ. for a zero indication on the FREQUENCY meter.

NOTE

This adjustment should be repeated as required each time before the FREQUENCY meter is read. Perform the adjustment after setting the FREQUENCY range switch to STANDBY. (After adjustment, return the switch to its previous setting.)

5.1.6 Set the Test Instrument FREQUENCY range switch to X1.

5.1.7 Adjust the Test Instrument AMPLITUDE INCREASE control fully cw.

5.2 CONTROL ADJUSTMENTS

5.2.1 Record the electronic counter indication. Verify that this indication is within tolerance; if not, adjust Test Instrument potentiometer R-185 (usually marked L, on the right-hand, upper side of the chassis; refer to the manufacturer's instruction manual for the exact location), to obtain an indication that is within tolerance.

NOTE

Frequency, in cycles per second, is equal to the reciprocal of the period in seconds.

5.2.2 Set the Test Instrument FREQUENCY range switch to X10.

5.2.3 Record the electronic counter indication. Verify that this indication is within tolerance; if not, adjust Test Instrument potentiometer R-186 (located on the back of the front panel on the right-hand side; refer to the manufacturer's instruction manual for the exact location), to obtain an indication that is within tolerance.

NOTE

In some instruments, R-186 may be out of the circuit on the X10 range. If it does not have any effect, adjust R-185 and repeat steps 5.1.6 and 5.2.1, adjusting R-186 (instead of R-185) as required, then perform step 5.2.2 before proceeding to step 5.2.4.

5.2.4 Adjust the Test Instrument FREQUENCY INCREASE control fully cw.

5.2.5 Record the electronic counter indication. Verify that this indication is within tolerance; if not, adjust Test Instrument potentiometer R-188 (usually marked H, on the right-hand upper side of the chassis; refer to the manufacturer's instruction manual for the exact location), to obtain an indication that is within tolerance, and repeat steps 5.2.1 through 5.2.5 after setting the Test Instrument FREQUENCY INCREASE control fully ccw and the FREQUENCY range switch to X1.

5.2.6 Set the Test Instrument FREQUENCY range switch to X1.

5.2.7 Record the electronic counter indication. Verify that this indication is within tolerance; if not, take the required corrective action and repeat steps 4.1.1 through 5.2.7 as applicable.

5.2.8 Adjust the Test Instrument FREQUENCY INCREASE control for the applicable electronic counter indication as follows:

Model 1100A	000500.00 milliseconds
Model 1100B	000333.00 milliseconds
Model 1100C	000167.00 milliseconds
Model 1100D	000500.00 milliseconds

5.2.9 Record the Test Instrument FREQUENCY meter indication. Verify that this indication is within tolerance; if not, adjust Test Instrument potentiometer R-142 (usually marked M, on the front right-hand upper side of the chassis; refer to the manufacturer's instruction manual for the exact

location), to obtain an indication that is within tolerance.

5.2.10 Adjust the Test Instrument FREQUENCY INCREASE control for a FREQUENCY meter indication of one-half scale.

5.2.11 Record the electronic counter indication. Verify that this indication is within tolerance; if not, take the required corrective action and repeat steps 4.1.1 through 5.2.11 as applicable.

5.2.12 Slow Synchro Transmitter Frequency Calibration

NOTE

This subsection is applicable only to model 1100D; for other models proceed to step 5.2.13.

NOTE

During this subsection, the frequency counter may take up to 17 minutes to count the period of one cycle.

5.2.12.1 Set the Test Instrument controls as follows:

High-low switch to	.001 to .2
FREQUENCY range switch to	X10
FREQUENCY INCREASE control	fully cw

5.2.12.2 Record the electronic counter indication. Verify that this indication is within tolerance; if not, take the required corrective action and repeat steps 4.1.1 through 5.2.12.2 as applicable.

5.2.12.3 Adjust the Test Instrument FREQUENCY INCREASE control fully ccw.

5.2.12.4 Set the electronic counter STD. FREQ. COUNTED switch to 10 CPS.

5.2.12.5 Record the electronic counter indication. Verify that this indication is within tolerance; if not, take the required corrective action and repeat steps 4.1.1 through 5.2.12.4 as applicable.

5.2.12.6 Set the Test Instrument FREQUENCY range switch to X1.

5.2.12.7 Record the electronic counter indication. Verify that this indication is within tolerance; if not, take the required corrective action and repeat steps 4.1.1 through 5.2.12.7 as applicable.

5.2.12.8 Adjust the Test Instrument FREQUENCY INCREASE control fully cw.

5.2.12.9 Record the electronic counter indication. Verify that this indication is within tolerance; if not, take the required corrective action and repeat steps 4.1.1 through 5.2.12.9 as applicable.

5.2.13 Disconnect the electronic counter.

6. SWEEP TESTS

6.1 INITIAL CONDITIONS

6.1.1 Verify that the Test Instrument controls are set as in step 5.1.1.

6.1.2 Set the oscilloscope controls as follows:

FOCUS control to	midrange
INTENSITY control	fully ccw
VERT. DC BAL. control to	midrange
HORIZ. DC BAL. control to	midrange
INPUT (vertical) switch to	DC
INPUT (horizontal) switch to	DC
VERT. POS. control to	midrange
HORIZ. POS. control to	midrange
VERT. SENSITIVITY switch to	5 VOLTS/CM
VERT. SENSITIVITY VERNIER	fully cw
SWEEP TIME/CM switch to	10 MILLISECONDS
SWEEP TIME/CM VERNIER	fully cw
HORIZ. SENSITIVITY switch to	5 VOLTS/CM
TRIGGER LEVEL control to	0
TRIGGER SLOPE switch cw to	+
SYNC. switch to	INT
SWEEP MODE control	fully cw

6.1.3 Connect the Test Instrument X-AXIS terminals to the oscilloscope left-hand (vertical) INPUT terminals. Ensure that circuit ground terminals are interconnected.

6.1.4 Adjust the oscilloscope INTENSITY, FOCUS, VERT. POS., and HORIZ, POS. controls are a sharp, clear, centered presentation.

6.1.5 Verify that a set of test leads is connected to the VOM as in step 4.1.5.

6.2 CONTROL ADJUSTMENTS

6.2.1 Adjust the oscilloscope VERT. SENSITIVITY VERNIER control for 6 centimeters of vertical deflection. Set the Test Instrument FREQUENCY switch to X10. Record the vertical amplitude of the oscilloscope presentation. Verify that this indication is within tolerance; if not, take the required corrective action, and repeat steps 4.1.1 through 6.2.1 as applicable.

6.2.2 Set the Test Instrument FREQUENCY range switch to X1.

6.2.3 Record the vertical amplitude of the oscilloscope presentation as the NOMINAL value. Adjust the Test Instrument FREQUENCY INCREASE control fully cw. Record the vertical amplitude as the MEASURED value. Verify that this indication is within tolerance; if within, proceed to step 6.2.4; if not, perform step 6.2.3.1 and repeat steps 6.1.1 through 6.2.3.

6.2.3.1 Adjust the Test Instrument FREQUENCY INCREASE control from one extreme to the other repeatedly; adjust potentiometer R-190 (usually marked S, near the center of the chassis; refer to the manufacturer's instruction manual for the exact location) as required to make the oscilloscope display appear to have the same vertical height at all positions of the control.

6.2.4 Verify that the Test Instrument FREQUENCY INCREASE control is fully cw.

6.2.5 Record the vertical amplitude of the oscilloscope presentation. Verify that this indication is within tolerance; if not, take the required corrective action and repeat steps 4.1.1 through 6.2.5 as applicable.

6.2.6 Adjust the Test Instrument FREQUENCY INCREASE control fully ccw.

6.2.7 Record the vertical amplitude of the oscilloscope presentation. Verify that this indication is within tolerance; if not, take the required corrective action and repeat steps 4.1.1 through 6.2.7 as applicable.

6.2.8 Set the Test Instrument FREQUENCY range switch to X10.

6.2.9 Record the vertical amplitude of the oscilloscope presentation. Verify that this indication is within tolerance; if not, take the required corrective action and repeat steps 4.1.1 through 6.2.9 as applicable.

6.2.10 Adjust the Test Instrument FREQUENCY INCREASE control fully cw.

6.2.11 Record the vertical amplitude of the oscilloscope presentation. Verify that this indication is within tolerance; if not, take the required corrective action and repeat steps 4.1.1 through 6.2.11 as applicable.

6.2.12 Set the oscilloscope HORIZ. SENSITIVITY switch to INT. SWEEP.

6.2.13 Adjust the Test Instrument FREQUENCY INCREASE control for a FREQUENCY meter indication of 16 cps.

6.2.14 Adjust the oscilloscope SWEEP MODE control for a single, stable presentation.

6.2.15 Compare the oscilloscope presentation with figure 2. If the waveform is not similar to the acceptable presentation, take the required corrective action, and repeat steps 4.1.1 through 6.2.15 as applicable.

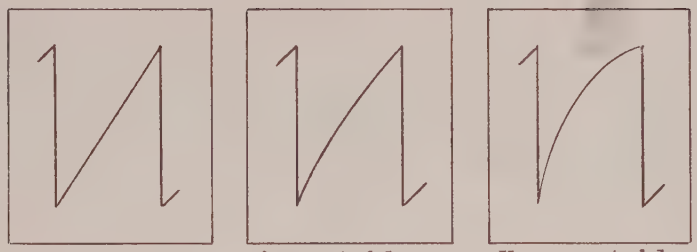

Figure 2. Sweep Waveforms

6.2.16 Set the VOM range selector to 40 VDC.

6.2.17 Matching polarity, connect the VOM to the Test Instrument X-AXIS terminals.

6.2.18 Adjust the Test Instrument SWEEP BALANCE control from one extreme to the other and observe the VOM for a smooth excursion (the VOM connections must be reversed each time the control passes 0). Any rough or erratic operation requires corrective action.

6.2.19 Adjust the Test Instrument SWEEP BALANCE for a zero indication on the VOM.

6.2.20 Disconnect the VOM.

6.2.21 Adjust the Test Instrument SWEEP WIDTH control from one extreme to the other, and observe the oscilloscope for a smooth excursion from minimum to maximum amplitude. Any rough or erratic operation requires corrective action.

7. PHASE TESTS

7.1 INITIAL CONDITIONS

7.1.1 X-Axis 60-cycle Reference Connection

7.1.1.1 Connect the oscilloscope HORIZONTAL INPUT terminals across the Test Instrument I201.

7.1.2 Connect the Test Instrument 50-800~ carrier power cord to the autotransformer.

CAUTION (for 1100B and C)

DO NOT SET FREQUENCY CONTROLS ABOVE 29 CPS WITH THE CARRIER ON.

7.1.2.1 Verify that the Test Instrument CARRIER light is illuminated; if not, take any required corrective action.

7.1.3 Verify that the Test Instrument X-AXIS terminals are connected to the oscilloscope left-hand (vertical) INPUT terminals.

7.1.4 Verify that the Test Instrument controls are set as in step 5.1.1 with the following exceptions:

X-AXIS switch to	REF.
AMPLITUDE INCREASE control	fully cw
FREQUENCY INCREASE control	fully cw
Function selector to	MOD. CARRIER

7.1.5 Verify that the oscilloscope controls are set as in step 6.1.2, except set the HORIZ. SENSITIVITY switch to 1 VOLT/CM.

7.1.6 Adjust the oscilloscope INTENSITY, FOCUS, VERT. POS., and HORIZ. POS. controls for a sharp, clear, centered presentation.

7.2 REFERENCE AMPLIFIER PHASE TEST

7.2.1 Set the oscilloscope VERT. SENSITIVITY switch and VERNIER as necessary to produce a line (or ellipse) slanted across the screen at approximately 45°.

7.2.2 Repeatedly set the FREQUENCY range switch to X1 and back to STANDBY. Observe the oscilloscope, and stop when the vertical deflection is approximately maximum.

7.2.3 Repeat step 7.2.1.

7.2.4 Adjust Test Instrument potentiometer R-163 (usually marked REF. PHASE, on the front, left-hand, upper side of the chassis; refer to the manufacturer's instruction manual for the exact location) for a straight line on the oscilloscope (the line may be curved, but the ellipse must be closed).

7.2.5 Disconnect the Test Instrument from the oscilloscope.

7.3 CARRIER AMPLIFIER PHASE TEST

7.3.1 Connect the Test Instrument OUTPUT terminals to the oscilloscope left-hand (vertical) INPUT terminals. Ensure that circuit ground terminals are interconnected.

7.3.2 Repeat step 7.2.1.

7.3.3 Adjust the Test Instrument PHASE dial for maximum vertical deflection of the oscilloscope display.

7.3.4 Repeat step 7.2.1.

7.3.5 Adjust Test Instrument potentiometer R-108 (usually marked SIG. PHASE, on the front, left-hand, upper side of the chassis; refer to the manufacturer's instruction manual for the exact location) for a straight line on the oscilloscope.

7.4 SYNCHRO CONTROL TRANSFORMER PHASE TEST

7.4.1 Connect the Test Instrument X-AXIS terminals to the oscilloscope right-hand INPUT terminals.

7.4.2 Set the Test Instrument FREQUENCY range switch to X1.

7.4.3 Adjust the Test Instrument FREQUENCY INCREASE control fully cw.

7.4.4 Set the oscilloscope HORIZ. SENSITIVITY switch and VERNIER for an image which does not quite reach the edge of the screen.

7.4.5 Adjust the Test Instrument PHASE dial for a straight line on the oscilloscope, slanting from the lower left corner of the screen to the upper right. The line should not appear to rotate; its ends will collapse and expand, but only in a straight line.

7.4.6 Record the PHASE dial indication. Verify that this indication is within tolerance; if within, proceed to step 7.5; if not, perform steps 7.4.6.1 through 7.4.6.3, then repeat steps 7.4.5 and 7.4.6.

7.4.6.1 Slightly loosen the three mounting screws holding the synchro control transformer (behind the PHASE dial) in place.

7.4.6.2 Adjust the Test Instrument PHASE dial to zero, and hold it there while adjusting the entire synchro control transformer for a straight line on the oscilloscope, slanting from the lower left corner of the screen to

the upper right.

7.4.6.3 Tighten the three mounting screws.

7.5 SLOW SYNCHRO TRANSMITTER PHASE TEST

NOTE

This subsection is applicable only to model 1100D; for other models proceed to subsection 7.6.

7.5.1 Set the Test Instrument controls as follows:

FREQUENCY range switch to	X10
High-low switch to	.001 to .2

7.5.2 Set the oscilloscope HORIZ. SENSITIVITY switch and VERNIER as necessary for an image which does not quite reach the edge of the screen.

7.5.3 Adjust the Test Instrument PHASE dial for a straight line as in step 7.4.5.

7.5.4 Record the Test Instrument PHASE dial indication. Verify that this indication is within tolerance; if within, proceed to step 7.5.5, if not, perform steps 7.5.4.1 through 7.5.4.4, and repeat steps 7.5.3 and 7.5.4.

7.5.4.1 Adjust the Test Instrument PHASE dial to 0.

7.5.4.2 Slightly loosen the three mounting screws holding the upper synchro transmitter to the lower one.

7.5.4.3 Adjust the upper synchro transmitter for a straight line as described in step 7.4.5.

7.5.4.4 Tighten the three mounting screws.

7.5.5 Set the Test Instrument controls as follows:

FREQUENCY range switch to	X1
High-low switch to	.1 to 20

7.6 SYNCHRO TRANSMITTER PHASE TEST

7.6.1 Set the Test Instrument X-AXIS switch to SWEEP.

7.6.2 Adjust the Test Instrument FREQUENCY INCREASE control for a FREQUENCY meter indication of 2 cps.

7.6.3 Set the oscilloscope HORIZ. SENSITIVITY switch and VERNIER as necessary for an image which does not quite reach the edge of the screen.

7.6.4 Adjust the Test Instrument PHASE dial for zero phase shift (refer to figure 3). (The modulation envelope must be set to zero at the start of the sweep.)

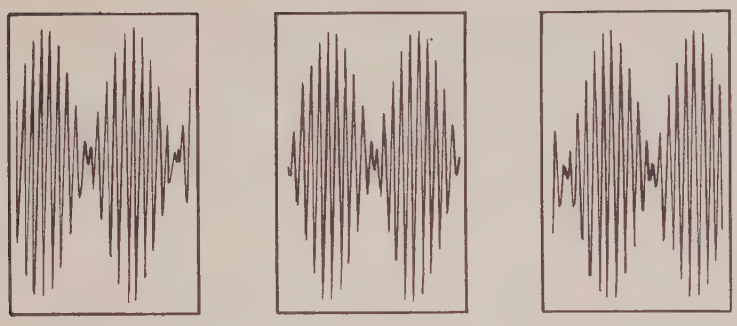

Figure 3. Phasing Waveforms

7.6.5 Record the Test Instrument PHASE dial indication. Verify that this indication is within tolerance; if within, proceed to step 7.6.6; if not; perform steps 7.6.5.1 through 7.6.5.4 and repeat steps 7.6.4 and 7.6.5.

7.6.5.1 Adjust the Test Instrument PHASE dial to zero.

7.6.5.2 Slightly loosen the three mounting screws holding the synchro transmitter(s) to the raised platform on the right-hand upper side of the chassis; refer to the manufacturer's instruction manual for the exact location.

7.6.5.3 Adjust the Test Instrument synchro transmitter(s) as necessary to produce zero phase shift as shown in figure 3.

7.6.5.4 Tighten the three mounting screws.

7.6.6 Adjust the PHASE dial through one complete revolution, and verify that the oscilloscope displays a smooth, linear phase shift.

7.6.7. Disconnect the Test Instrument 50-800~ carrier power cord.

8. WAVEFORM TESTS

8.1 INITIAL CONDITIONS

8.1.1 Verify that the Test Instrument controls are set as in step 5.1.1 with the following exceptions:

Function selector to	SQUARE WAVE
FREQUENCY range switch to	X10
AMPLITUDE INCREASE control	fully cw

8.1.2 Adjust the Test Instrument FREQUENCY INCREASE control for an indication of 2 cps on the FREQUENCY meter.

8.1.3 Verify that the oscilloscope left-hand (vertical) terminals are connected to the Test Instrument OUTPUT terminals, and that the right-hand (horizontal) terminals are connected to the X-AXIS terminals.

8.1.4 Verify that the oscilloscope controls are set as in step 6.1.2.

8.1.5 Adjust the oscilloscope INTENSITY, FOCUS, VERT. POS., HORIZ. POS., and VERT. SENSITIVITY controls for a sharp, clear, centered presentation.

8.2 CONTROL ADJUSTMENTS

8.2.1 Adjust the Test Instrument FREQUENCY INCREASE control from one extreme to the other, and adjust potentiometer R-111 (usually marked SQ, on the front, left-hand, upper side of the chassis; refer to the manufacturer's instruction manual for the exact location) for an acceptable square wave over the entire range (refer to figure 4).

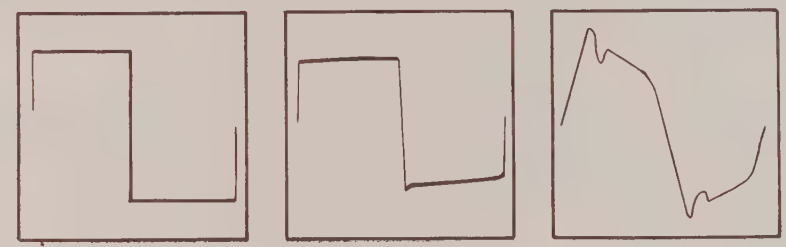

Figure 4. Square-wave Waveforms

8.2.2 Set the oscilloscope controls as follows:

VERT. SENSITIVITY switch to	5 VOLTS/CM
VERT. SENSITIVITY VERNIER	fully cw

8.2.3 Record the square wave peak-to-peak vertical amplitude in centimeters. Verify that this indication is within tolerance; if not, take the required corrective action, and repeat steps 4.1.1 through 8.2.3 as applicable.

8.2.4 Set the Test Instrument function selector to SINE WAVE.

8.2.5 Compare the oscilloscope presentation with figure 5. If the waveform is not similar to the acceptable presentation, take the required corrective action and repeat steps 4.1.1 through 8.2.5 as applicable.

Acceptable

Figure 5. Sine-wave Waveform

8.2.6 Record the sine wave peak-to-peak vertical amplitude in centimeters. Verify that this indication is within tolerance; if not, take the required corrective action and repeat steps 4.1.1 through 8.2.6 as applicable.

8.2.7 Set the Test Instrument FREQUENCY range switch to STANDBY.

8.2.8 Adjust the Test Instrument PHASE dial, as necessary, until the AMPLITUDE meter indication is as small as possible.

8.2.9 Adjust the Test Instrument AMPLITUDE INCREASE control fully ccw.

8.2.10 Adjust the Test Instrument D.C. ZERO ADJ. for a zero indication on the AMPLITUDE meter.

8.2.11 Connect the EVM INPUT terminals to the Test Instrument OUTPUT terminals. Verify that the circuit ground terminals are interconnected.

8.2.12 Set the EVM Range switch ccw to each position, successively, until the meter indicates between full scale and 1/3 of full scale.

8.2.13 Record the EVM indication. Verify that this indication is within tolerance; if not, take the required corrective action and repeat steps 4.1.1 through 8.2.12 as applicable.

8.2.14 Set the EVM Range switch to 300 VOLTS.

9. TEST INSTRUMENT EVALUATION

9.1 Complete the calibration checklist, and verify that the Test Instrument is in acceptable condition. If not, take the required corrective action, repeat steps 4.1.1 through 8.2.14 as applicable, then re-evaluate the Test Instrument.

9.2 Unless other measurements are to be performed, turn off all equipment power and disconnect the Test Instrument.

9.3 Replace the Test Instrument case, bottom panel, and screws removed in steps 3.1.1 and 4.1.3.

APPENDIX A

EQUIPMENT SUBSTITUTION REQUIREMENTS

The following is a brief summary of the minimum instrumentation requirements for performing the calibration. This information is intended to assist those laboratories which find it necessary to substitute for one or more items listed in section 2 of this procedure, and does not imply that such substitutions will permit satisfactory performance. A trial calibration should be performed critically, using the substitute equipment, and all resulting changes to methods and instructions must be inserted in the procedure copies to be used with the substitute equipment. Only the principal equipment items are considered in this appendix; it is not intended to be a complete list, and those items whose substitution requirements are obvious have been omitted.

2.1	Oscilloscope:	General purpose; with provision for external sweep; calibrated vertical attenuator
2.2	VOM:	Ranges, 0 to 50 dv, 0 to 400 dv, and 0 to 160 av; sensitivity, 20000 ohms/volt dv, 5000 ohms/volt av; accuracy: ±3% dv and ±5% av
2.3	Counter, electronic:	Capable of measuring the period of low frequency signals
2.4	Divider, voltage:	Calibrated; 4 decades; input resistance, 10,000 ohms; accuracy ±0.1%
2.5	Source, AC reference:	60 cps; calibrated output; variable; 0.1 volt steps to 60 volts; accuracy ±0.5%

TEST INST (S): SEB 1100A Servoscope

PROC NO. NW 17-20AQ-01 MFR MODEL SER NO.

PROCEDURE STEP NO. (1)	FUNCTION TESTED (2)	NOMINAL (3)	MEASURED VALUES FIRST RUN (4)	MEASURED VALUES SECOND RUN (5)	OUT OF TOL ✓ (6)	CALIBRATION TOLERANCES (7)
3.2.3	Mechanical Zero	--	ck ( )			
3.2.9	Amplitude Meter Test	50.0v				48.5 to 51.5v
3.2.11	"	40.0v				38.5 to 41.5v
3.2.13	"	30.0v				28.5 to 31.5v
3.2.15	"	20.0v				18.5 to 21.5v
3.2.17	"	10.0v				8.5 to 11.5v
3.3.11	POWER light	--	ck ( )			
4.2.4	B+ Power Test	+300.0v				+270.0 to +330.0v
4.3.3	+300v Test	+300.0v				+280.0 to +320.0v
4.3.5	" (Regulation)					±3.0v
4.4.4	+150v Test	+150.0v				+140.0 to +160.0v
4.4.6	" "					±1.5v
4.5.4	-150v Test	-150.0v				-160.0 to -140.0v
4.5.6	" "					±1.5v
4.6.4	-300v Test	-300.0v				-320.0 to -280.0v
4.6.6	" "					±3.0v
5.	Frequency Tests	ms				ms
5.2.1	X1 min.	10500.00				10000.00 to 11000.00
5.2.3	X10 min.	1050.00				1000.00 to 1100.00
5.2.5	X10 max.	47.60				45.20 to 50.00
5.2.7	X1 max.	476.00				452.00 to 500.00
5.2.9	Meter Full-Scale	2 cps				1.94 to 2.06 cps
5.2.11	Meter Half-Scale	1000.0ms				970.00 to 1030.00 ms
6.	Sweep Tests					
6.2.1	Time Constant	--				4.5 to 5.4 cm
6.2.3	Lgth/Freq. Diff.					±0.5 cm
6.2.5	X1 max.	--				4.0 cm min.
6.2.7	X1 min.	--				"
6.2.9	X10 min.	--				"
6.2.11	X10 max.	--				"

NAVY CALIBRATION CHECKLIST-CONTINUATION
11ND-BWR-5512/9A (5-62)

SECTION D

TEST INST (S): SEB 1100A Servoscope

PROC NO. NW 17-20AQ-01 MFR MODEL SER NO.

PROCEDURE STEP NO. (1)	FUNCTION TESTED (2)	NOMINAL (3)	MEASURED VALUES FIRST RUN (4)	MEASURED VALUES SECOND RUN (5)	OUT OF TOL ✓ (6)	CALIBRATION TOLERANCES (7)
6.2.15	Sweep Mode	--	ck ( )			
6.2.18	" Balance	--	ck ( )			
6.2.21	" Width	--	ck ( )			
7.1.2.1	CARRIER lamp	--	ck ( )			
7.2.4	Adj. R163(REF. PHASE)	--	ck ( )			
7.3.5	Adj. R108(SIG. PHASE)	--	ck ( )			
7.4	Synchro Control Transformer Phase Tests					
7.4.6	Control Trans.	0°				±2.0°
7.6.5	Transmitter	0°				±2.0°
7.6.6	Adj. PHASE dial 360°	--	ck ( )			
8.	Waveform Tests					
8.2.1	Adj. R111 (SQ)	--	ck ( )			
8.2.3	Square Wave Amp.	7.0 cm				4.0 to 10.0 cm
8.2.5	Sine Wave	--	ck ( )			--
8.2.6	Sine Wave Amp.	7.0 cm				4.0 to 10.0 cm
8.2.13	Ripple	--				4.0 mv max.

TEST INST ($): SEB 1100B Servoscope

PROC NO. NW 17-20AQ-01 MFR MODEL SER NO.

PROCEDURE STEP NO. (1)	FUNCTION TESTED (2)	NOMINAL (3)	MEASURED VALUES FIRST RUN (4)	MEASURED VALUES SECOND RUN (5)	OUT OF TOL ✓ (6)	CALIBRATION TOLERANCES (7)
3.2.3	Mechanical Zero	--	ck ( )			
3.2.9	Amplitude Meter Test	50.0v				48.5 to 51.5v
3.2.11	"	40.0v				38.5 to 41.5v
3.2.13	"	30.0v				28.5 to 31.5v
3.2.15	"	20.0v				18.5 to 21.5v
3.2.17	"	10.0v				8.5 to 11.5v
3.3.11	POWER light	--	ck ( )			
4.2.4	B+ Power Test	+300.0v				+270.0 to +330.0v
4.3.3	+300v Test	"				+280.0 to +320.0v
4.3.5	" (Regulation)					±3.0v
4.4.4	+150v Test	+150.0v				+140.0 to +160.0v
4.4.6	" "					±1.5v
4.5.4	-150v Test	-150.0v				-160.0 to -140.0v
4.5.6	" "					±1.5v
4.6.4	-300v Test	-300.0v				-320.0 to -280.0v
4.6.6	" "					±3.0v
5.	Frequency Tests	ms				ms
5.2.1	X1 min.	7020.00				6670.00 to 7370.00
5.2.3	X10 min.	702.00				667.00 to 737.00
5.2.5	X10 max.	31.80				30.30 to 33.30
5.2.7	X1 max.	318.00				303.00 to 333.00
5.2.9	Meter Full-Scale	3 cps				2.91 to 3.09 cps
5.2.11	Meter Half-Scale	667.0ms				647.00 to 687.00 ms
6.	Sweep Tests					
6.2.1	Time Constant	--				4.5 to 5.4 cm
6.2.3	Lgth/Freq. Diff.					±0.5 cm
6.2.5	X1 max.	--				4.0 cm min.
6.2.7	X1 min.	--				"
6.2.9	X10 min.	--				"
6.2.11	X10 max.	--				"

NAVY CALIBRATION CHECKLIST-CONTINUATION
11ND-BWR-5512/9A (5-62)

SECTION D

TEST INST (S):
SEB 1100B Servoscope

PROC NO. NW 17-20AQ-01 MFR MODEL SER NO.

PROCEDURE STEP NO. (1)	FUNCTION TESTED (2)	NOMINAL (3)	MEASURED VALUES FIRST RUN (4)	MEASURED VALUES SECOND RUN (5)	OUT OF TOL ✓ (6)	CALIBRATION TOLERANCES (7)
6.2.15	Sweep Mode	--	ck ( )			
6.2.18	" Balance	--	ck ( )			
6.2.21	" Width	--	ck ( )			
7.1.2.1	CARRIER lamp	--	ck ( )			
7.2.4	Adj. R163(REF. PHASE)	--	ck ( )			
7.3.5	Adj. R108(SIG. PHASE)	--	ck ( )			
7.4	Synchro Control Transformer Phase Tests					
7.4.6	Control Trans.	0°				±2.0°
7.6.5	Transmitter	0°				±2.0°
7.6.6	Adj. PHASE dial 360°	--	ck ( )			
8.	Waveform Tests					
8.2.1	Adj. R111 (SQ)	--	ck ( )			
8.2.3	Square Wave Amp.	7.0 cm				4.0 to 10.0 cm
8.2.5	Sine Wave	--	ck ( )			--
8.2.6	Sine Wave Amp.	7.0 cm				4.0 to 10.0 cm
8.2.13	Ripple	--				4.0 mv max.

TEST INST (S): SEB 1100C Servoscope

PROC NO. NW 17-20AQ-01 MFR MODEL SER NO.

PROCEDURE STEP NO. (1)	FUNCTION TESTED (2)	NOMINAL (3)	MEASURED VALUES FIRST RUN (4)	MEASURED VALUES SECOND RUN (5)	OUT OF TOL ✓ (6)	CALIBRATION TOLERANCES (7)
3.2.3	Mechanical Zero	--	ck ( )			
3.2.9	Amplitude Meter Test	50.0v				48.5 to 51.5v
3.2.11	"	40.0v				38.5 to 41.5v
3.2.13	"	30.0v				28.5 to 31.5v
3.2.15	"	20.0v				18.5 to 21.5v
3.2.17	"	10.0v				8.5 to 11.5v
3.3.11	POWER light	--	ck ( )			
4.2.4	B+ Power Test	+300.0v				+270.0 to +330.0v
4.3.3	+300v Test	+300.0v				+280.0 to +320.0v
4.3.5	" (Regulation)					±3.0v
4.4.4	+150v Test	+150.0v				+140.0 to +160.0v
4.4.6	" "					±1.5v
4.5.4	-150v Test	-150.0v				-160.0 to -140.0v
4.5.6	" "					±1.5v
4.6.4	-300v Test	-300.0v				-320.0 to -280.0v
4.6.6	" "					±3.0v
5.	Frequency Tests	ms				ms
5.2.1	X1 min.	3510.00				3330.00 to 3690.00
5.2.3	X10 min.	351.00				330.00 to 369.00
5.2.5	X10 max.	15.90				15.10 to 16.70
5.2.7	X1 max.	159.00				151.00 to 167.00
5.2.9	Meter Full-Scale	6 cps				5.82 to 6.18 cps
5.2.11	Meter Half-Scale	333.0 ms				323.00 to 343.00 ms
6.	Sweep Tests					
6.2.1	Time Constant	--				4.5 to 5.4 cm
6.2.3	Lgth/Freq. Diff.					±0.5 cm
6.2.5	X1 max.	--				4.0 cm min.
6.2.7	X1 min.	--				"
6.2.9	X10 min.	--				"
6.2.11	X10 max.	--				"

NAVY CALIBRATION CHECKLIST-CONTINUATION
11ND-BWR-5512/9A (5-62)

SECTION D

TEST INST (S): SEB 1100C Servoscope

PROC NO. NW 17-20AQ-01 MFR MODEL SER NO.

PROCEDURE STEP NO. (1)	FUNCTION TESTED (2)	NOMINAL (3)	MEASURED VALUES FIRST RUN (4)	MEASURED VALUES SECOND RUN (5)	OUT OF TOL ✓ (6)	CALIBRATION TOLERANCES (7)
6.2.15	Sweep Mode	--	ck ( )			
6.2.18	" Balance	--	ck ( )			
6.2.21	" Width	--	ck ( )			
7.1.2.1	CARRIER lamp	--	ck ( )			
7.2.4	Adj. R163(REF. PHASE)	--	ck ( )			
7.3.5	Adj. R108(SIG. PHASE)	--	ck ( )			
7.4	Synchro Control Transformer Phase Tests					
7.4.6	Control Trans.	0°				±2.0°
7.6.5	Transmitter	0°				±2.0°
7.6.6	Adj. PHASE dial 360°	--	ck ( )			
8.	Waveform Tests					
8.2.1	Adj. R111 (SQ)	--	ck ( )			
8.2.3	Square Wave Amp	7.0 cm				4.0 to 10.0 cm
8.2.5	Sine Wave	--	ck ( )			--
8.2.6	Sine Wave Amp	7.0 cm				4.0 to 10.0 cm
8.2.13	Ripple	--				4.0 mv max.

TEST INST (S): SEB 1100D Servoscope

PROC NO. NW 17-20AQ-01 MFR MODEL SER NO.

PROCEDURE STEP NO. (1)	FUNCTION TESTED (2)	NOMINAL (3)	MEASURED VALUES FIRST RUN (4)	MEASURED VALUES SECOND RUN (5)	OUT OF TOL ✓ (6)	CALIBRATION TOLERANCES (7)
3.2.3	Mechanical Zero	--	ck ( )			
3.2.9	Amplitude Meter Test	50.0v				48.5 to 51.5v
3.2.11	"	40.0v				38.5 to 41.5v
3.2.13	"	30.0v				28.5 to 31.5v
3.2.15	"	20.0v				18.5 to 21.5v
3.2.17	"	10.0v				8.5 to 11.5v
3.3.11	POWER light	--	ck ( )			
4.2.4	B+ Power Test	+300.0v				+270.0 to +330.0v
4.3.3	+300v Test	+300.0v				+280.0 to +320.0v
4.3.5	" (Regulation)					±3.0v
4.4.4	+150v Test	+150.0v				+140.0 to +160.0v
4.4.6	" "					±1.5v
4.5.4	-150v Test	-150.0v				-160.0 to -140.0v
4.5.6	" "					±1.5v
4.6.4	-300v Test	-300.0v				-320.0 to -280.0v
4.6.6	" "					±3.0v
5.	Frequency Tests	ms				ms
5.2.1	Hi X1 min.	10500.00				10000.00 to 11000.00
5.2.3	Hi X10 min.	1050.00				1000.00 to 1100.00
5.2.5	Hi X10 max.	47.60				45.20 to 50.00
5.2.7	Hi X1 max.	476.00				452.00 to 500.00
5.2.9	Meter Full-Scale	2 cps				1.94 to 2.06 cps
5.2.11	Meter Half-Scale	1000.0 ms				970.00 to 1030.00 ms
5.2.12.2	Lo X10 max.	4760.0 ms				4520.00 to 5000.00 ms
5.2.12.5	Lo X10 min.	105.0 sec				100.00 to 110.00 sec
5.2.12.7	Lo X1 min.	1050.0 "				1000.00 to 1100.00 "
5.2.12.9	Lo X1 max.	47.6 "				45.20 to 50.00 "
6.	Sweep Tests					
6.2.1	Time Constant	--				4.5 to 5.4 cm
6.2.3	Lgth/Freq. Diff.					±0.5 cm
6.2.5	X1 max.	--				4.0 cm min.
6.2.7	X1 min.	--				"
6.2.9	X10 min.	--				"

NAVY CALIBRATION CHECKLIST-CONTINUATION
11ND-BWR-5512/9A (5-62)

SECTION D

TEST INST (S):
SEB 1100D Servoscope

PROC NO. NW 17-20AQ-01 MFR MODEL SER NO.

PROCEDURE STEP NO. (1)	FUNCTION TESTED (2)	NOMINAL (3)	MEASURED VALUES FIRST RUN (4)	MEASURED VALUES SECOND RUN (5)	OUT OF TOL ✓ (6)	CALIBRATION TOLERANCES (7)
6.2.11	X10 max.	--				4.0 cm min.
6.2.15	Sweep Mode	--	ck ( )			
6.2.18	Sweep Balance	--	ck ( )			
6.2.21	" Width	--	ck ( )			
7.1.2.1	CARRIER lamp	--	ck ( )			
7.2.4	Adj. R163(REF. PHASE)	--	ck ( )			
7.3.5	Adj. R108(SIG. PHASE)	--	ck ( )			
7.4	Synchro Control Transformer Phase Tests					
7.4.6	Control Trans.	0°				±2.0°
7.5.4	Slow Transmitter	"				"
7.6.5	Transmitter	"				"
7.6.6	Adj. PHASE dial 360°	--	ck ( )			
8.	Waveform Tests					
8.2.1	Adj. R111 (SQ)	--	ck ( )			
8.2.3	Square Wave Amp	7.0 cm				4.0 to 10.0 cm
8.2.5	Sine Wave	--	ck ( )			--
8.2.6	Sine Wave Amp	7.0 cm				4.0 to 10.0 cm
8.2.13	Ripple	--				4.0 mv max.

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